# MODIS LEVEL 1B 1km EARTH VIEW DATA PRODUCT FORMAT
Version 2.1 Release 1
June 22, 1998

If a packet hits a pocket on a MODIS product port
And the process is interrupted as a very last resort,
And the address of the memory tells the process to abort,
Then the packet pocket product has an error to report!

With apologies to "If Dr. Seuss Were a Technical Writer"....
J. Blanchette

## Purpose

This document specifies the format and content of the MODIS Level 1B 1 kilometer Earth View data product, one of the four files designated as MOD02. MOD02 is stored as four Hierarchical Data Format (HDF) files for each granule of MODIS data, containing:

- Earth View observations for MODIS bands 1 and 2, at 250 meter resolution;
- Earth View observations from MODIS bands 1 and 2, aggregated at 500 meter resolution, plus the Earth View observations from MODIS bands 3 through 7, at 500 meter resolution;
- Earth View observations from MODIS bands 1 through 7, aggregated at 1 kilometer resolution, plus the Earth View observations from MODIS bands 8 through 36, at 1 kilometer resolution;
- On Board Calibrator observations from all MODIS bands, at their original resolution, plus the Engineering data.

This 1 km Earth View data file contains a subset of geolocation data to support plotting and visualization.

This specification describes five types of metadata and one type of science data stored in the Level 1B 1km Earth View data product.

The indexing is described in terms of C, which is row dominant.

## Metadata

The five types of metadata are Core, Archive, Product, QA, Swath, and SDS. The Core, Archive and Product metadata are stored as global attributes. The Swath metadata is stored in two forms, as swath attributes for HDF-EOS

required swath metadata, and as Vdata for Level 1B specific swath metadata. The SDS metadata is stored as Science Data Set (SDS) attributes.

The ECS required metadata in this file is written with the Science Data Processing Tool Kit (SDPTK) tools, so that it may be read with these tools.

Core metadata satisfies the ECS requirements to provide granule level information for ingesting, cataloging, and searching data products. The content and format of the Core metadata is defined by ECS.

Archive metadata provides granule level information that is archived with the product, but which is not stored in the searchable ECS database.

Product metadata satisfies the MODIS mission's requirement to track MODIS specific data at the granule level. The granule level information is output as global metadata elements stored using the HDF Attribute, in accordance with ECS guidelines

Swath metadata provides HDF-EOS required fields, instrument information, the nadir frame number, the latitude and longitude of the nadir frame, processing information and quality information about a particular swath of MODIS data.

## Science Data

The science data in this file is Instrument data and a subset of geolocation data stored as multiple SDSs in HDF-EOS Swath format. Separation of the complete set of geolocation data from the swath was approved by ECS for the MODIS project as a means of reducing redundant storage of the geolocation data in every product. The small subset of geolocation data stored in this file is for convenience in imaging and visualization.

The dimensions of the SDSs are defined using HDF dimension names. Attributes associated with an HDF dimension are inherited by any SDS using that dimension name. This technique is used to provide multiple SDSs which have a common dimension with information such as band names, units, and scale and offset values.

## Instrument SDSs

The target in the file described by this specification is the Earth View (EV) scene. The instrument data for the four calibration targets viewed by MODIS are stored in the OBC/Engineering file. The data at each resolution, for the EV scene, is in an SDS, so that there are the following four instrument data SDSs:

reflected solar band calibrated data at 250 M resolution aggregated to 1 km,
reflected solar band calibrated data at 500 M resolution aggregated to 1 km,
reflected solar band calibrated data at 1 km resolution,
emissive thermal band calibrated data at 1 km resolution.

The data in the instrument SDSs are scaled integers. Meaningful geophysical products are derived from these integer data sets through use of scaling factors and offsets provided in the SDS dimension attributes.

When the MODIS instrument is commanded to operate in night mode, the data taken by the Reflective Solar Band detectors is not telemetered down from the spacecraft. The SDSs for Reflective Solar Band data exist for all granules, but contain no data when the instrument is operating in night mode for the entire granule. The SDSs for Reflective Solar Band data contain fill data at the beginning or end of the granule when the instrument operations switch between day mode and night mode within the granule.

Dimension names are stored as attributes of the swath in the HDF-EOS swath metadata. The numbers of the bands in each SDS, the units of the calibrated data, and the scale and offset values for converting the integers to calibrated geophysical parameters are provided as SDS dimension attributes. These attributes are described in terms of ncdump output, where x.f represents a float32 value.

There is one scale and offset pair which provides the corrected raw counts, DN*, and two pairs of scale and offset values which provide radiance or reflectance related values, for each band. The emissive bands are reported as radiance products only. After multiplying by the scale and adding the offset to the integer values to restore them to calibrated geophysical quantities, the corrected counts will be in units of counts, the radiances will be in units of $\text{Watts} / \text{m}^2 / \mu\text{m} / \text{steradian}$; the reflectance related values [(EV BRF) * (cosine of the Solar Zenith Angle)] will be in units of per steradian. Thus,
radiance ($\text{Watts} / \text{m}^2 / \mu\text{m} / \text{steradian}$)=radiance scale(band#) * unsigned integer values + radiance offset (band#). The band dependent scales and offsets are determined as

$scale = 1.2\left[\frac{L_{MAX_{band}}}{2^{15}-1}\right]$, and $offset = -0.2\left[\frac{L_{MAX_{band}}}{2^{15}-1}\right]$, where $LMAX_{band}$ is the maximum radiance value for a band, and is defined to be 80% of the possible range. In terms of the reflectance related product, the band dependent scales and offsets are

$scale = 1.2\left[\frac{(\rho\cos\theta)_{MAX_{band}}}{2^{15}-1}\right]$, $offset = -0.2\left[\frac{(\rho\cos\theta)_{MAX_{band}}}{2^{15}-1}\right]$,

where $\left(\rho\cos\Theta_{MAX_{band}}\right) = \frac{\pi}{E_{SUN_{nd}}} L_{MAX_{band}}$ .

The relationship between reflectance ($\rho_{EV}$) and radiance ($L_{EV}$) is given by the equation $\rho_{EV} \cos(\Theta_{EV}) = \frac{\pi L_{EV,B,D}}{E_{Sun,B}}$, and is determined at the top of the atmosphere. See the MODIS Level 1B Algorithm Theoretical Basis Document, 1996.

The numbers assigned by the hardware engineers to the detectors on the instrument are the reverse of the data storage numbering. The data in the Level 1A, Geolocation and Level 1B files is stored in the along-track direction. The nearest along-track data in a scan is collected by detector 10, for 1 km bands, and the data farthest along-track is collected by detector 1. The pixel data within a band are stored this way so that consecutive swaths or scans can be "laid down" directly onto a map and have the correct continuity across each swath. All indexing and data ordering in this file are consistent, so that there is no need to explicitly transform between detector ordering and data ordering.

Invalid data fields are identified by having the high order bit set to 1. The data in a field is marked as invalid for the following reasons:

it was flagged as missing from the Level 1A dataset;
the detector is dead;
the value was saturated;
there was a calibration failure;
the radiance was too low to calculate;
there was coherent Space View (SV) noise;
the number of outliers in the SV data exceeded the maximum;
there was a mirror side difference in the SV data.

Thus any data value larger than 32767 should be interpreted as invalid data.

The values in data fields that are flagged as missing from the Level 1A dataset are copied into the Level 1B file exactly as they are stored in the Level 1A file. In the Level 1A file these values are -1, stored as signed 16 bit integers. In the Level 1B file these values are 65535, stored as unsigned 16 bit integers.

For invalid data that is not missing data, the actual value stored in the file is the value that is calculated by the algorithm, altered by having the high order bit set to 1.

The specific cause of all invalid data is reported in the QA log message file.

## Other SDSs

### Uncertainties SDSs

**NOTE: At this point MCST is not yet certain that we have the optimum design for the Uncertainty Index and the Scene Contrast Index described in this section so that they are of optimal use to the science user. Any user who plans to start using these indexes before the Version 2.1 release of the Level 1B software should contact MCST directly.**

The product contains the flat-field uncertainty for MODIS, on a band averaged basis. The information is provided in two pieces: one piece is the instrument specification values; the second piece is the best estimate of what is actually accomplished, recorded as a multiplicative factor to be used with the instrument specification value.

The estimated uncertainty carried with each pixel is an eight bit field containing two indexes. The Scene Contrast Index is in the high order four bits and the Uncertainty Index described below is in the low order four bits.

The Scene Contrast Index includes near- and far-field effects. The concepts which describe the Scene Contrast Index are TBD at this time.

The Uncertainty Index is carried as a multiplicative factor to be applied to the instrument specifications. The instrument specifications are provided below, and may be stored in the Collect Level metadata, which is TBD. The uncertainty is recorded as an index which includes MCST's complete and best understanding of the flat-field uncertainties for that pixel. The index translates to an uncertainty value by use of the formula

$$\exp(\text{Uncertainty Index}/2) = \pm\text{Uncertainty Range Multiplier Value.}$$

The uncertainty is carried in the one-sigma sense. This index can be considered a Risk Index describing the use of the Level 1B data. An Uncertainty Index of 7 indicates that the uncertainty has not been computed.

As an example, for Band 9, one sigma is 5% of $L_{typ}$. Since $L_{typ} = 41.9$, one sigma $= (.05)(41.9) = 2.095$. If the uncertainty index has a value of 3, the magnitude of the uncertainty for Band 9 is $e^{3/2}(2.095)$, or $(4.5)(2.096) = 9.43$.

| Uncertainty Index Value | Multiplier Range (1 Sigma) |
|---|---|
| 0 | ±1 |
| 1 | ±1.6 |
| 2 | ±2.7 |
| 3 | ±4.5 |
| 4 | ±7.4 |
| 5 | ±12 |
| 6 | ±20 |
| 7 | greater than 20, index not computed |

| Band | Spectral Radiance Spec. ($L_{typ}$) | Accuracy Requrement at $L_{typ}$ | Band | Spectral Radiance Spec. ($L_{typ}$) | Accuracy Requrement at $L_{typ}$ |
|---|---|---|---|---|---|
| 1 | 21.8 | 5% | 18 | 3.6 | 5% |
| 2 | 24.7 | 5% | 19 | 15.0 | 5% |
| 3 | 35.3 | 5% | 20 | 0.45 | 0.75% |
| 4 | 29.0 | 5% | 21 | 2.38 | 1% |
| 5 | 5.4 | 5% | 22 | 0.67 | 1% |
| 6 | 7.3 | 5% | 23 | 0.79 | 1% |
| 7 | 1.0 | 5% | 24 | 0.17 | 1% |
| 8 | 44.9 | 5% | 25 | 0.59 | 1% |
| 9 | 41.9 | 5% | 26 | 6.00 | 5% |
| 10 | 32.1 | 5% | 27 | 1.16 | 1% |
| 11 | 27.9 | 5% | 28 | 2.18 | 1% |
| 12 | 21.0 | 5% | 29 | 9.58 | 1% |
| 13lo | 9.5 | 5% | 30 | 3.69 | 1% |
| 13hi | 9.5 | 5% | 31 | 9.55 | 0.50% |
| 14lo | 8.7 | 5% | 32 | 8.94 | 0.50% |
| 14hi | 8.7 | 5% | 33 | 4.52 | 1% |
| 15 | 10.2 | 5% | 34 | 3.76 | 1% |
| 16 | 6.2 | 5% | 35 | 3.11 | 1% |
| 17 | 10.0 | 5% | 36 | 2.08 | 1% |

Note that MODIS is a 36 spectral band instrument but contains high and low gain data streams for two spectral bands. Consequently, the SDSs are dimensioned to store 38 data streams.

The center wavelengths for each band are in given below. This information may also be stored in the Collect level metadata, which is TBD.

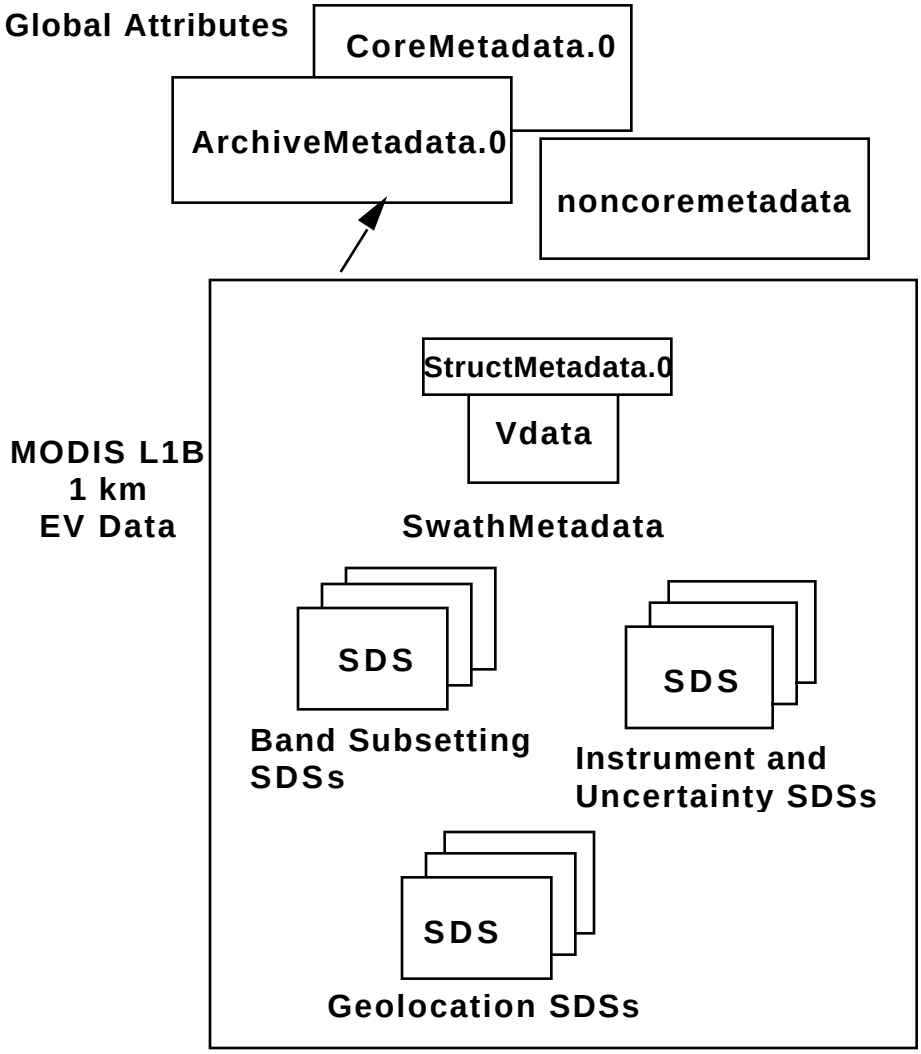
| Band | Center Wavelength | Band | Center Wavelength | Band | Center Wavelength |
|---|---|---|---|---|---|
| 1 | 645.0 | 13lo | 667.0 | 23 | 4050.0 |
| 2 | 858.0 | 13hi | 667.0 | 24 | 4470.0 |
| 3 | 469.0 | 14lo | 678.0 | 25 | 4520.0 |
| 4 | 555.0 | 14hi | 678.0 | 26 | 1375.0 |
| 5 | 1240.0 | 15 | 748.0 | 27 | 6720.0 |
| 6 | 1640.0 | 16 | 869.0 | 28 | 7330.0 |
| 7 | 2130.0 | 17 | 905.0 | 29 | 8550.0 |
| 8 | 412.0 | 18 | 936.0 | 30 | 9730.0 |
| 9 | 443.0 | 19 | 940.0 | 31 | 11030.0 |
| 10 | 488.0 | 20 | 3750.0 | 32 | 12020.0 |
| 11 | 531.0 | 21 | 3960.0 | 33 | 13340.0 |
| 12 | 551.0 | 22 | 3960.0 | 34 | 13640.0 |
| | | | | 35 | 13940.0 |
| | | | | 36 | 14240.0 |

## Geolocation SDSs

The Geolocation SDSs contain a subset of the MODIS Geolocation file used to generate this file. In each scan, starting with the third frame of the Earth View sector and for every fifth frame after that, Geolocation fields for the third and eighth lines of data, corresponding to 1 km resolution bands, are copied directly from the Geolocation file. The Geolocation fields are latitude, longitude, height, sensor zenith, sensor azimuth, range, solar zenith, and solar azimuth. Refer to the MODIS Geolocation Product Specification for a complete description. Interpolating over these locations to approximate geolocation values for the intervening frames or lines of data will not provide the accuracy available in the MODIS Geolocation file.

## Band Subsetting SDSs

The Band Subsetting SDSs support ECS subsetting of the band dimensions.




**Level 1B HDF Format**

**Global Metadata**

| ECS Standard Core Granule Metadata<br>Stored as One ECS PVL String in :coremetadata.0=Global Attribute | |
|---|---|
| **Description** | **Example** |
| LOCALGRANULEID | "MOD021KM.A1996218.1555.002.1998 152115306.hdf" |
| PRODUCTIONDATETIME | "1998-06-01T15:53:08.000Z" |
| DAYNIGHTFLAG | "Day" or "Night" or "Both" |
| REPROCESSINGACTUAL | "processed once" |
| REPROCESSINGPLANNED | "no further update anticipated" |
| SIZEMBECSDATAGRANULE | set by "DSS" |
| EASTBOUNDINGCOORDINATE | 40.000000 |
| WESTBOUNDINGCOORDINATE | 15.000000 |
| NORTHBOUNDINGCOORDINATE | 25.000000 |
| SOUTHBOUNDINGCOORDINATE | 10.000000 |
| AUTOMATICQUALITYFLAGEXPLANATION | "not being investigated" |
| AUTOMATICQUALITYFLAG | "Passed" |
| OPERATIONALQUALITYFLAGEXPLANATION | set by "DAAC" |
| OPERATIONALQUALITYFLAG | set by "DAAC" |
| SCIENCEQUALITYFLAGEXPLANATION | set by "DP" |
| SCIENCEQUALITYFLAG | set by "DP" |
| QAPERCENTMISSINGDATA | 0 |
| QAPERCENTINTERPOLATEDDATA | 0 |
| QAPERCENTOUTOFBOUNDSDATA | 0 |
| PARAMETERNAME | "EV_1KM_RefSB", "EV_1KM_Emissive"" |
| EQUATORCROSSINGDATE | "1996-08-05" |
| EQUATORCROSSINGTIME | "15:55:45.854788" |
| ORBITNUMBER | 88 |
| EQUATORCROSSINGLONGITUDE | -73.021282 |
| VERSIONID | "2.1" |
| SHORTNAME | "MOD021KM" |
| INPUTPOINTER | "L1A_v2_10scans_0", "L1A_v2_10scans_1", "L1A_v2_10scans_2", "Reflective_Lookup_Tables_file", "Emissive_Lookup_Tables_file", "QA_Lookup_Tables_file" |
| GRINGPOINTLONGITUDE | (-86.567558, -59.389000, -59.836601, -86.653564) |
| GRINGPOINTLATITUDE | (41.644032, 37.729759, 36.824055, 40.686016) |

| | |
|---|---|
| GRINGPOINTSEQUENCENO | (1, 2, 3, 4) |
| EXCLUSIONGRINGFLAG | "N" |
| RANGEENDINGDATE | "1996-08-05" |
| RANGEENDINGTIME | "15:56:00.626488" |
| RANGEBEGINNINGDATE | "1996-08-05" |
| RANGEBEGINNINGTIME | "15:55:45.854788" |
| PGEVERSION | "2" |
| ANCILLARYINPUTPOINTER | "/l1b/scratch/Data/L1A_data/Geoloc_v2_10scans" |
| ANCILLARYINPUTTYPE | "Geolocation" |
| ADDITIONALATTRIBUTENAME.1 | "AveragedBlackBodyTemperature" |
| PARAMETERVALUE.1 | 290.0 |
| ADDITIONALATTRIBUTENAME.2 | "AveragedMirrorTemperature" |
| PARAMETERVALUE.2 | 295.0 |
| ADDITIONALATTRIBUTENAME.3 | "AveragedFocalPlane1Temperature" |
| PARAMETERVALUE.3 | 292.0 |
| ADDITIONALATTRIBUTENAME.4 | "AveragedFocalPlane2Temperature" |
| PARAMETERVALUE.4 | 295.0 |
| ADDITIONALATTRIBUTENAME.5 | "AveragedFocalPlane3Temperature" |
| PARAMETERVALUE.5 | 297.0 |
| ADDITIONALATTRIBUTENAME.6 | "AveragedFocalPlane4Temperature" |
| PARAMETERVALUE.6 | 291.0 |
| ADDITIONALATTRIBUTENAME.7 | "CalibrationQuality" |
| PARAMETERVALUE.7 | "marginal" |
| ADDITIONALATTRIBUTENAME.8 | "MissionPhase" |
| PARAMETERVALUE.8 | "A&E" |
| ADDITIONALATTRIBUTENAME.9 | "NadirPointing" |
| PARAMETERVALUE.9 | "Y" |

| **MODIS Level 1B Archive Granule Metadata<br>Stored as HDF ECS PVL in :archivemetadata.0=Global Attribute** | |
|---|---|
| **Description** | **Example** |
| ALGORITHMPACKAGEACCEPTANCEDATE | "1998-04-01" |
| ALGORITHMPACKAGEMATURITYCODE | " launch" |
| ALGORITHMPACKAGENAME | "MOD02V2.1" |
| ALGORITHMPACKAGEVERSION | "version 2.1" |
| INSTRUMENTNAME | "Moderate-Resolution Imaging SpectroRadiometer" |
| PLATFORMSHORTNAME | "EOS AM1" |
| PROCESSINGCENTER | "GSFC" |

| MODIS Level 1B Product Granule Metadata<br>Stored as Native HDF Global Attributes | | |
|---|---|---|
| **Description** | **Format** | **Example** |
| "Number of Scans" | Int32 | 203 |
| "Number of Day mode scans" | Int32 | 203 |
| "Number of Night mode scans" | Int32 | 0 |
| "Incomplete Scans" | Int32 | 14 |
| “Max Earth View Frames” | Int32 | 1354 |
| "%Valid EV Observations" | float32[38] | 98.2,..., 87.1,..,46.0,... |
| "%Saturated EV Observations" | float32[38] | 1.4,..., 0.2,...,7.9,... |
| “Post Processing Indicates Bad data” | Int32[38] | 1=True; 0=False |
| “Electronics Redundancy Vector” | uint32[2] | One bit set to 0 for Side A or 1 for Side B, for each programmable component |
| “Reflective LUT serial number” | string | “R0” |
| “Emissive LUT serial number” | string | “E0” |
| “QA LUT serial number” | string | “Q0” |
| “Focal Plane Set Point State” | Int8[4] | 0=Running open loop<br>1=Set Point is 83 degrees<br>2=Set Point is 85 degrees<br>3=Set Point is 88 degrees |

| MODIS Level 1B QA Granule Metadata<br>Stored as Native HDF Global Attributes | | |
|---|---|---|
| **Description** | **Format** | **Example** |
| “Doors and Screens Configuration” | int8 | 2 |
| “Managers VIS/NIR Quality Index” | int32 | 0 |
| “Managers SWIR Quality Index” | int32 | 0 |
| “Managers MWIR/LWIR Quality Index” | int32 | 0 |
| “Reflective Bands With Bad Data” | int8[22] | 1,0,0,1... |
| “Emissive Bands With Bad Data” | int8[16] | 1,0,0,1... |
| “All L1B Error Flags Off” | int8 | 0 |
| “Noise in Black Body Thermistors” | uint8[12] | 10 |
| “Noise in Average BB Temperature” | uint8 | 10 |
| “Noise in LWIR FPA Temperature” | uint8 | 10 |
| “Noise in MWIR FPA Temperature” | uint8 | 10 |
| “Noise in Scan Mirror Thermistor #1” | uint8 | 10 |
| “Noise in Scan Mirror Thermistor #2” | uint8 | 10 |
| “Noise in Scan Mirror Thermistor Average” | uint8 | 10 |
| “Noise in Instrument Temperature” | uint8 | 10 |
| “Noise in MWIR ADC Temperature” | uint8 | 10 |
| “Noise in LWIR ADS Temperature” | uint8 | 10 |

| | | |
|---|---|---|
| "Noise in Cavity Temperature" | uint8 | 10 |
| "Noise in Thermal Detectors" | uint8[16][10] | 8,6,4... |
| "Change in relative responses of thermal detectors" | uint8[16][10] | 10,6,8... |
| "Change in response since per-launch" | uint8 | 10 |
| "Noise in Temperature of NIR FPA" | uint8 | 10 |
| "Noise in Temperature of Vis FPA" | uint8 | 10 |
| "Noise in VIS ADC Temperature" | uint8 | 10 |
| "Noise in NIR 1 km ADC Temperature" | uint8 | 10 |
| "Noise in band 1 ADC Temperature" | uint8 | 10 |
| "Noise in band 2 ADC Temperature" | uint8 | 10 |
| "Noise in SWIR Bands ADC Temperature" | uint8 | 10 |
| "DC Restore Change for Thermal Bands" | int8[nscans][16][10] | 0,0,1 ... |
| "DC Restore Change for Reflective 250 m Bands" | int8[nscans][2][40] | 0,0,1... |
| "DC Restore Change for Reflective 500 m Bands" | int8[nscans][5][20] | 0,0,1... |
| "DC Restore Change for Reflective 1 km Bands" | int8[nscans][15][10] | 0,0,1... |

**Level 1B HDF-EOS Swath Metadata**
**Stored as HDF ECS PVL in :StructMetadata.0=Global Attribute**

```
GROUP=SwathStructure
   GROUP=SWATH_1
     SwathName="MODIS_Swath_Type_L1B"
     GROUP=Dimension
       Dimension_1, "Band_250M", Size=2
       Dimension_2, "Band_500M", Size=5
       Dimension_3, "Band_1KM_RefSB", Size=15
       Dimension_4, "Band_1KM_Emissive, Size=16
          Dimension_5, "10*nscans", Size=10*nscans
       Dimension_6, "Max_EV_frames", Size=Max_EV_frames
       Dimension_7, "2*nscans", Size=2*nscans
       Dimension_8, "Max_EV_frames/5", Size=Max_EV_frames/5
     GROUP=DimensionMap
       DimensionMap_1, GeoDimension="2*nscans",
                              DataDimension="10*nscans", Offset=2, Increment=5
       DimensionMap_2, GeoDimension=" Max_EV_frames/5",
                          DataDimension=" Max_EV_frames", Offset=2, Increment=5
     GROUP=GeoField
       GeoField_1, "Latitude", DFNT_FLOAT32,
                                                ("2*nscans","Max_EV_frames/5")
       GeoField_2, "Longitude", DFNT_FLOAT32,
                                                ("2*nscans","Max_EV_frames/5")
```

```
GROUP=DataField

  DataField_1, “EV_250_Aggr1km_RefSB”, DFNT_UINT16,
                                (“Band-250M”, “10*nscans”, “Max_EV_frames”)
  DataField_2, “EV_250M_Aggr1km_RefSB_Uncert_Indexes”,
            DFNT_UINT8,  (“Band_250M”, “10*nscans”, “Max_EV_frames”)
  DataField_3, “EV_500_Aggr1km_RefSB”, DFNT_UINT16,
                               (“Band_500M”, “10*nscans”, “Max_EV_frames”)
  DataField_4, “EV_500M_Aggr1km_RefSB_Uncert_Indexes”,
            DFNT_UINT8,  (“Band_500M”, “10*nscans”, “Max_EV_frames”)
  DataField_5, “EV_1KM_RefSB”, DFNT_UINT16,
                     (“Band_1KM_RefSB”, “10*nscans”, “Max_EV_frames”)
  DataField_6, “EV_1KM_RefSB_Uncert_Indexes”, DFNT_UINT8,
                     (“Band_1KM_RefSB”, “10*nscans”, “Max_EV_frames”)
  DataField_7, “EV_1KM_Emissive”, DFNT_UINT16,
                   (“Band_1KM_Emissive”, “10*nscans”, “Max_EV_frames”)
  DataField_8, “EV_1KM_Emissive_Uncert_Indexes”, DFNT_UINT8,
                   (“Band_1KM_Emissive”, “10*nscans”, “Max_EV_frames”)
  DataField_9, “Height”, DFNT_INT16, (“2*nscans”, “Max_EV_frames/5”)
  DataField_10, “SensorZenith”, DFNT_INT16,
                                          (“2*nscans”, “Max_EV_frames/5”)
  DataField_11, “SensorAzimuth”, DFNT_INT16,
                                          (“2*nscans”, “Max_EV_frames/5”)
  DataField_12, “Range”, DFNT_INT16, (“2*nscans”, “Max_EV_frames/5”)
  DataField_13, “SolarZenith”, DFNT_INT16,
                                          (“2*nscans”, “Max_EV_frames/5”)
  DataField_14, “SolarAzimuth”, DFNT_INT16,
                                          (“2*nscans”, “Max_EV_frames/5”)
  DataField_15, “gflags”, DFNT_INT8,
                                          (“2*nscans”, “Max_EV_frames/5”)
  DataField_16, “EV_250_Aggr1km_RefSB_Samples_Used”, DFNT_INT8,
                               (“Band_250M”, “10*nscans”, “Max_EV_frames”)
  DataField_16, “EV_500_Aggr1km_RefSB_Samples_Used”, DFNT_INT8,
                               (“Band_500M”, “10*nscans”, “Max_EV_frames”)
```

| "Level 1B Specific Swath Metadata" Written as Vdata with the Following Fields | | |
|---|---|---|
| **Field** | **Type** | **Typical value** |
| Scan Number | int32 | Range 1 to 100 |
| Complete Scan Flag | int32 | Complete=1, Incomplete=0 |
| Scan Type | char8[4] | "D "=day, "N "=night, "M "=mixed, "O "=other |
| Mirror Side | int32 | 1 or 2 |
| EV Sector Start Time | float64 | TAI: Sec. since midnight 1/1/93 |
| Programmed_EV_Frames | int32 | 1514 |
| EV_Frames | int32 | 1354 |
| Nadir_Frame_Number | int32 | 677 |
| Latitude of Nadir Frame | float32 | -90.0 to 90.0 in degrees |
| Longitude of Nadir Frame | float32 | -180.0 to 180.0 in degrees |
| Solar Azimuth of Nadir Frame | float32 | -180 to 180 degrees |
| Solar Zenith of Nadir Frame | float32 | 0.0 to 180.0 in degrees |
| No. thermistor outliers | int32 | Range 0 to 12 |
| Bit QA Flags | int32 | 1=True; 0=False |
| Moon in SV Port | bit 0 | |
| Spacecraft Maneuver | bit 1 | |
| Sector Rotation | bit 2 | |
| Negative Radiance Beyond Noise Level | bit 3 | |
| PC Ecal on | bit 4 | |
| PV Ecal on | bit 5 | |
| SD Door Open | bit 6 | |
| SD Screen Down | bit 7 | |
| SRCA On | bit 8 | |
| SDSM On | bit 9 | |
| Outgassing | bit 10 | |
| Instrument Standby Mode | bit 11 | |
| Linear Emissive Calibration | bit 12 | |
| DC Restore Change | bit 13 | |
| BB/Cavity Temperature Differential | bit 14 | |
| BB Heater On | bit 15 | |
| Missing Previous Granule | bit 16 | |
| Missing Subsequent Granule | bit 17 | |
| Remaining 14 bits reserved for future use | bits 18 - 31 | |

| Band Subsetting SDSs | | |
|---|---|---|
| **SDS Name** | **Data Type** | **HDF Dimension Names** |
| "Band_250M" | float32 | floating point array of dimension (Band_250M) |
| Band_250M SDS Attributes:<br>long_name ="250M Band Numbers for Subsetting"<br>Note: The values stored in this array are 1.0 and 2.0<br>Band_250M Dimension Attributes:<br>band_names = "1, 2"<br>radiance_scales = x.f, x.f<br>radiance_offsets = x.f, x.f<br>radiance_units = "Watts / $m^2$ /µm / steradian"<br>reflectance_scales = x.f, x.f<br>reflectance_offsets = x.f, x.f<br>reflectance_units = "1 / steradian"<br>corrected_counts_scales = x.f, x.f<br>corrected_counts_offsets = x.f, x.f<br>corrected_counts_units = "counts" | | |
| "Band_500M" | float32 | floating point array of dimension (Band_250M) |
| Band_500M SDS Attributes:<br>long_name ="500M Band Numbers for Subsetting"<br>Note: The values stored in this array are 3.0, 4.0, 5.0, 6.0, and 7.0<br>Band_500M Dimension Attributes:<br>band_names = "3, 4, 5, 6, 7"<br>radiance_scales = x.f, x.f, x.f, x.f, x.f<br>radiance_offsets = x.f, x.f, x.f, x.f, x.f<br>radiance_units = "Watts / $m^2$ /µm / steradian"<br>reflectance_scales = x.f, x.f, x.f, x.f, x.f<br>reflectance_offsets = x.f, x.f, x.f, x.f, x.f<br>reflectance_units = "1 / steradian"<br>corrected_counts_scales = x.f, x.f, x.f, x.f, x.f<br>corrected_counts_offsets = x.f, x.f, x.f, x.f, x.f<br>corrected_counts_units = "counts" | | |
| "Band_1KM_RefSB " | float32 | floating point array of dimension (Band_1KM_RefSB) |

Band_1KM_RefSB SDS Attributes:
long_name ="1KM Reflective Solar Band Numbers for Subsetting"
Note: The values stored in this array are 8.0, 9.0, 10.0, 11.0, 12.0, 13.0, 13.5, 14.0, 14.5, 15.0, 16.0, 17.0, 18.0, 19.0 and 26.0
Band_1KM_RefSB Dimension Attributes:
band_names = “8, 9, 10, 11, 12, 13lo, 13hi, 14lo, 14hi, 15, 16, 17, 18, 19, 26”
radiance_scales = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f
radiance_offsets x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f
radiance_units = “Watts / $m^2$ / μm / steradian”
reflectance_scales = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f
reflectance_offsets = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f
reflectance_units = “1 / steradian”
corrected_counts_scales = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f
corrected_counts_offsets = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f
corrected_counts_units = “counts”

| | | |
|---|---|---|
| "Band_1KM_Emissive " | float32 | floating point array of dimension (Band_1KM_Emissive) |

Band_1KM_Emissive SDS Attributes:
long_name ="1KM Emissive Band Numbers for Subsetting"
Note: The values stored in this array are 20.0, 21.0, 22.0, 23.0, 24.0, 25.0, 27.0, 28.0, 29.0, 30.0, 31.0, 32.0, 33.0, 34.0, 35.0, 36.0
Band_1KM_Emissive Dimension Attributes:
band_names = “20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36”
radiance_scales = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f
radiance_offsets = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f
radiance_units = “Watts / $m^2$ / μm / steradian”
corrected_counts_scales = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f
corrected_counts_offsets = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f
corrected_counts_units = “counts”

| Instrument and Uncertainty SDSs | | |
|---|---|---|
| **SDS Name** | **Data Type** | **HDF Dimension Names** |
| "EV_250_Aggr1km_RefSB" | uint16 | 16 bit scaled integer array of dimension (Band_250M, 10*nscans, Max_EV_frames) |
| EV_250_Aggr1km_RefSB SDS Attributes:<br>long_name ="Earth View 250M Aggregated 1km Reflected Solar Bands Scaled Integers"<br>Band_250M Dimension Attributes:<br>band_names = "1, 2"<br>radiance_scales = x.f, x.f<br>radiance_offsets = x.f, x.f<br>radiance_units = "Watts / $m^2$ / μm / steradian"<br>reflectance_scales = x.f, x.f<br>reflectance_offsets = x.f, x.f<br>reflectance_units = "1 / steradian"<br>corrected_counts_scales = x.f, x.f<br>corrected_counts_offsets = x.f, x.f<br>corrected_counts_units = "counts" | | |
| "EV_250_Aggr1km_RefSB_Uncert_Indexes" | uint8 | 8 bit integer array of dimension (Band_250M, 10*nscans, Max_EV_frames) |
| EV_250_Aggr1km_RefSB_Uncert_Indexes SDS Attributes:<br>long_name ="Earth View 250M Aggregated 1km Reflected Solar Bands Uncertainty Indexes" | | |
| "EV_250_Aggr1km_RefSB_Samples_Used" | int8 | 8 bit integer array of dimension (Band_250M, 10*nscans, Max_EV_frames) |
| EV_250_Aggr1km_RefSB_Samples_Used SDS Attributes:<br>long_name ="Earth View 250M Aggregated 1km Reflected Solar Bands Number of Samples Used in Aggregation" | | |
| "EV_500_Aggr1km_RefSB" | uint16 | 16 bit scaled integer array of dimension (Band_500M, 10*nscans, Max_EV_frames) |

| | | |
|---|---|---|
| EV_500_RefSB SDS Attributes:<br>long_name ="Earth View 500M Aggregated 1km Reflected Solar Bands Scaled Integers"<br>Band_500M Dimension Attributes:<br>band_names = “3, 4, 5, 6, 7”<br>radiance_scales = x.f, x.f, x.f, x.f, x.f<br>radiance_offsets = x.f, x.f, x.f, x.f, x.f<br>radiance_units = “Watts / $m^2$ / µm / steradian”<br>reflectance_scales = x.f, x.f, x.f, x.f, x.f<br>reflectance_offsets = x.f, x.f, x.f, x.f, x.f<br>reflectance_units = “1 / steradian”<br>corrected_counts_scales = x.f, x.f, x.f, x.f, x.f<br>corrected_counts_offsets = x.f, x.f, x.f, x.f, x.f<br>corrected_counts_units = “counts” | | |
| "EV_500_Aggr1km_RefSB_Uncert_Indexes" | uint8 | 8 bit integer array of dimension (Band_500M, 10*nscans, Max_EV_frames) |
| EV_500_RefSB_Uncert_Indexes SDS Attributes:<br>long_name ="Earth View 500M Aggregated 1km Reflected Solar Bands Uncertainty Indexes" | | |
| "EV_500_Aggr1km_RefSB_Samples_Used” | int8 | 8 bit integer array of dimension (Band_500M, 10*nscans, Max_EV_frames) |
| EV_500_Aggr1km_RefSB_Samples_Used SDS Attributes:<br>long_name ="Earth View 500M Aggregated 1km Reflected Solar Bands Number of Samples Used in Aggregation" | | |
| "EV_1KM_RefSB" | uint16 | 16 bit scaled integer array of dimension (Band_1KM_RefSB,10*nscans,Max_EV_frames) |
| EV_1KM_RefSB SDS Attributes:<br>long_name ="Earth View 1KM Reflected Solar Bands Scaled Integers"<br>Band_1KM_RefSB Dimension Attributes:<br>band_names = “8, 9, 10, 11, 12, 13lo, 13hi, 14lo, 14hi, 15, 16, 17, 18, 19, 26”<br>radiance_scales = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f<br>radiance_offsets x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f<br>radiance_units = “Watts / $m^2$ / µm / steradian”<br>reflectance_scales = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f<br>reflectance_offsets = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f<br>reflectance_units = “1 / steradian”<br>corrected_counts_scales = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f<br>corrected_counts_offsets = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f<br>corrected_counts_units = “counts” | | |
| "EV_1KM_RefSB_Uncert_Indexes" | uint8 | 8 bit integer array of dimension (Band_1KM_RefSB,10*nscans,Max_EV_frames) |
| EV_1KM_RefSB_Uncert_Indexes SDS Attributes:<br>long_name ="Earth View 1KM Reflected Solar Bands Uncertainty Indexes" | | |

| | | |
|---|---|---|
| "EV_1KM_Emissive" | uint16 | 16 bit scaled integer array of dimension (Band_1KM_Emissive, 10*nscans, Max_EV_frames,) |
| EV_1KM_Emissive SDS Attributes:<br>long_name ="Earth View 1KM Emissive Bands Scaled Integers"<br>Band_1KM_Emissive Dimension Attributes:<br>band_names = “20, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36”<br>radiance_scales = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f<br>radiance_offsets = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f<br>radiance_units = “$Watts/m^2/\mu m/steradian$”<br>corrected_counts_scales = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f<br>corrected_counts_offsets = x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f, x.f<br>corrected_counts_units = “counts” | | |
| "EV_1KM_Emissive_Uncert_Indexes" | uint8 | 8 bit integer array of dimension (Band_1KM_Emissive, 10*nscans, Max_EV_frames,) |
| EV_1KM_Emissive_Uncert_Indexes SDS Attributes:<br>long_name ="Earth View 1KM Emissive Bands Uncertainty Indexes" | | |

| **Geolocation SDSs** | | |
|---|---|---|
| **SDS Name** | **Data Type** | **HDF Dimension Names** |
| "Latitude" | float32 | 32 bit floating point array of dimension (2*nscans, Max_EV_frames/5) |
| Latitude SDS Attributes:<br>units = degrees<br>valid_range = -180.0, 180.0<br>_FillValue = -999.9<br>line_numbers = [3, 8]<br>frame_numbers = [3, 8, 13,...] | | |
| "Longitude" | float32 | 32 bit floating point array of dimension (2*nscans, Max_EV_frames/5) |
| Longitude SDS Attributes:<br>units = degrees<br>valid_range = -90.0, 90.0<br>_FillValue = -999.9<br>line_numbers = [3, 8]<br>frame_numbers = [3, 8, 13,...] | | |
| "Height" | int16 | 16 bit integer array of dimension (2*nscans, Max_EV_frames/5) |

| | | |
|---|---|---|
| Height SDS Attributes:<br>units = meters<br>valid_range = 0, 10000<br>_FillValue = -32767<br>line_numbers = [3, 8]<br>frame_numbers = [3, 8, 13,...]<br>scale_factor = 0.01 | | |
| "SensorZenith" | int16 | 16 bit integer array of dimension<br>(2*nscans, Max_EV_frames/5) |
| SensorZenith SDS Attributes:<br>units = degrees<br>valid_range = 0, 15730<br>_FillValue = -32767<br>line_numbers = 3, 8<br>frame_numbers = 3, 8, 13,...<br>scale_factor = 0.01 | | |
| "SensorAzimuth" | int16 | 16 bit integer array of dimension<br>(2*nscans, Max_EV_frames/5) |
| SensorAzimuth SDS Attributes:<br>units = degrees<br>valid_range = -3146<br>line_numbers = [3, 8]<br>frame_numbers = [3, 8, 13,...]<br>scale_factor = 0.01 | | |
| "Range" | uint16 | 16 bit unsigned integer array of dimension<br>(2*nscans, Max_EV_frames/5) |
| Range SDS Attributes:<br>units = meters<br>valid_range = 27000,65535<br>_FillValue = 0<br>line_numbers = [3, 8]<br>frame_numbers = [3, 8, 13,...]<br>scale_factor = 50 | | |
| "SolarZenith" | int16 | 16 bit integer array of dimension<br>(2*nscans, Max_EV_frames/5) |
| SolarZenith SDS Attributes:<br>units = degrees<br>valid_range = 0, 31460<br>_FillValue = -32767<br>line_numbers = [3, 8]<br>frame_numbers = [3, 8, 13,...]<br>scale_factor = 0.01 | | |
| "SolarAzimuth" | int16 | 16 bit integer array of dimension<br>(2*nscans, Max_EV_frames/5) |

| | | |
|---|---|---|
| SolarAzimuth SDS Attributes:<br>units = degrees<br>valid_range = -31460, 31460<br>_FillValue = -32767<br>line_numbers = [3, 8]<br>frame_numbers = [3, 8, 13,...]<br>scale_factor = 0.01 | | |
| "gflags" | int8 | 8 bit integer array of dimension<br>(2*nscans, Max_EV_frames/5) |
| gflags SDS Attributes:<br>Bit 0: 1 = invalid input data<br>Bit 1: 1 = no ellipsoid intersection<br>Bit 2: 1 = no valid terrain data<br>Bit 3: 1 = invalid sensor angles<br>Bit 4: 1 = invalid solar angles | | |